ORIGINAL ARTICLE

Prevalence of Chronic Kidney Disease and Its Associated Factors among Type-2 Diabetes Mellitus Patients at Kuantan Primary Health Clinics

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ABSTRACT

INTRODUCTION: Chronic kidney disease (CKD) in type-2 diabetes mellitus (T2DM) patients leads to end-stage renal failure and cardiovascular complications. This study aims to determine the prevalence of CKD and its associated factors at primary health clinics in Kuantan. **MATERIALS AND METHODS:** 304 T2DM patients' records aged 18 years and above were retrospectively selected by systematic random sampling in four health clinics, analyzed using descriptive statistics and multiple logistic regression. CKD is defined as positive proteinuria, or microalbuminuria in at least two of three consecutive urine specimens or calculated eGFR <60ml/min/1.73 m2 for more than three months. **RESULTS:** The mean age was 59.1 +8.89 years, 69.1% (n=210) Malay and 57.6% (n=175) females. The prevalence of CKD among T2DM was 55.3% (n=168) (95% CI=54.8 to 55.9%). Out of 168 T2DM with CKD, 87.5% (n=147) had diabetes for ≥ five years, 90.5% (n=152) had at least two comorbidities, and 54.2% (n=91) were on insulin. Glycaemic (HbA1c<7%) and blood pressure(<130/80) among T2DM with CKD achieved targets were 28% (n=64) and 38.1% (n=47) respectively. Multivariable analysis showed higher odds of having CKD among T2DM with poor blood pressure (AOR=2.634, p-value=0.001) and glycaemic control (AOR=4.178, p-value=<0.001) compared to those with good control and among those with retinopathy (mild NPDR AOR=7.472, p-value=<0.001; moderate NPDR AOR=13.594, p-value=<0.001) compared to no retinopathy. **CONCLUSION:** CKD present in half of T2DM. It's associated with poor blood pressure, glycaemic control and retinopathy. Early detection of retinopathy and CKD, and aggressive diabetic intervention are vital to curbing CKD progression.

Keywords
Chronic Kidney Disease, Type-2 Diabetes Mellitus, Primary Health Clinics.

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INTRODUCTION

Malaysia exhibits the highest prevalence of type-2 diabetes mellitus (T2DM) within the Western Pacific area and ranks among the highest globally.[1] It is projected that the prevalence of T2DM among Malaysian people aged 18 and above will reach 7 million individuals by the year 2025.[2] The prevalence of chronic kidney disease (CKD) is also anticipated to be higher, as T2DM is a significant contributing factor to the development of CKD. The prevalence of CKD has been reported to range from 16.8% to 83.7%, showing variability across different stages of CKD.[3–6] Diabetes continues to be the primary risk factor associated with the onset and progression of CKD. T2DM with kidney disease observed an increased mortality risk. Among T2DM without kidney disease, standardized mortality was found to be 11.5% (95% CI, 7.9%–15.2%) and may be increased to 31.1% (95% CI, 24.7%–37.5%) among those with kidney disease.[7] In 2019, there were around 2.5 million reported cases of CKD that

were associated with T2DM on a global scale. This high prevalence of CKD contributed to more than 400,000 mortality and 10 million disability-adjusted life years (DALYs). Unfortunately, the Asia Continent exhibits the highest prevalence of CKD associated with diabetes, especially in South and East Asia. While in Europe, the prevalence of chronic kidney disease (CKD) in T2DM is almost half of the prevalence in Asia.[8]

Patients with CKD have a significantly high risk of developing renal failure, cardiovascular disease, and premature mortality. The transition of CKD to end-stage renal disease (ESRD) is a significant clinical event that carries considerable morbidity, especially among older individuals. It has been estimated that approximately 9% of cardiovascular mortality per year is due to CKD.[9] Given the numerous complications and the high-risk nature associated with CKD, it becomes one of the major concerns that must be emphasized in the management of T2DM at the primary care level. It is imperative to appraise sociodemographic and clinical background such as diabetes treatments, duration of diabetes, as well as glycaemic and blood pressure control among primary care T2DM patients. The primary objective of this study was to assess the prevalence of T2DM patients with CKD in primary health clinics and its associated factors in Kuantan, Malaysia. Thus, an appropriate measure of intervention may be considered to delay the progression of CKD among T2DM patients.

MATERIALS AND METHODS

This cross-sectional retrospective study was conducted on a study population of 13826 registered active diabetic patients getting treatment from 12 government health clinics in Kuantan, Malaysia. Secondary data was collected from October 2021 to March 2022 from clinical diabetic records available in the four largest government health clinics using a purposive sampling method after ethical approval. These data were collected manually from the patient's diabetic records system, done by using systematic random sampling of the population of primary care T2DM patients where every sixth person on the alphabetically arranged list name was chosen and identified according to inclusion and exclusion criteria. The inclusion criteria were adult T2DM patients (aged 18 years old and above) with a follow-up of at least two visits per year and availability of blood and urine parameters (HbA1c, renal profile and urine protein) within the last six months. Patients who had lost follow-up for the past 12 months or incomplete clinical data were excluded from selection.

The sample size was calculated using a single proportion formula using OpenEpi version 3. Based on the latest report in Northern Thailand[6], the expected prevalence of CKD is 24%, with an absolute precision of 5% and a non-response rate of 10%. Therefore, the minimum sample required was 304. The sample size of each clinic was based on the proportion of diabetic patients, for a total of 304. A data collection form developed explicitly for this study was used to obtain the information needed. The retrieved information comprised the sociodemographic and clinical data, including age, gender, race, anthropometric measurements, body mass index (BMI), duration of diabetes in years, smoking status, blood pressure (BP), laboratory results (HbA1c, low-density lipoprotein cholesterol-LDL), comorbidities (hypertension, hyperlipidaemia, and obesity) and the grades of diabetic retinopathy. Data on treatment, oral glucose-lowering drugs (OGLDs) only, insulin, or both were also gathered. The diagnosis of CKD was made either by looking at the patient's urine albumin excretion (UACR) and/or calculating the glomerular filtration rate (eGFR). All information available in the hard copy of patients' records was collected manually.

Chronic kidney disease (CKD) was defined as positive proteinuria or microalbuminuria on two out of three consecutive urine specimens, repeated after three to six months, or a calculated eGFR of less than 60ml/ min/1.73m2 that has been present for more than three months in the absence of other causes of kidney disease, such as glomerulonephritis, IgA nephropathy (IgAN) and autoimmune conditions.[10] Good glycaemic control was defined as the latest HbA1c of less than 7% (cut-off level for CKD patients) during data collection time within a six-month period, while good blood pressure control was defined as the latest recorded BP of less than 130/80 mmHg for patients with CKD or less than 140/80 mmHg

for patients without CKD. Good LDL control was defined as less than 2.6 mmol/L. All defined parameters were based on the Malaysian Clinical Practice Guidelines (CPG) on the management of T2DM (6th edition).[11]

The results were analysed using the IBM® SPSS® Statistics software version 20.0 for descriptive statistics. All categorical variables were summarised using frequencies and percentages (%), whereas the normally distributed continuous variables were described using mean and standard deviation (SD). Otherwise, median and interquartile ranges were used to describe the non-normally distributed continuous variables. Simple and multiple logistic regression analyses were performed using StataIC 15 software to assess the socio-demographic factors and clinical characteristics associated with CKD in T2DM patients in this study. The results were presented as odds ratio (OR) for simple logistic regression or adjusted OR for multiple logistic regression with a confidence interval (CI) of 95%. All the available variables were tested in the simple logistic regression so that significant variables were captured and included in the multiple logistic regression model. The final model with only significant variables from the multiple logistic regression was then checked for multicollinearity using the variation inflation factor (VIF) test and further checked for the model fitness using the classification table, area under the receiver operating characteristic (ROC) curve, also Pearson and Hosmer-Lemeshow chi-square tests, which all showed good model fitness.

RESULTS

304 records of T2DM patients from the four largest government health clinics in Kuantan were studied. Majority were Malays (n=210, 69.1%) and females (n=175, 57.6%). Overall, 44.1% (n=134) of the patients were older than 60. The prevalence of CKD among T2DM patients at the time of the study was 55.3% (n=168, 95% CI=49.7, 60.9). Table I describes the T2DM patients' sociodemographic and clinical characteristics as a whole and according to the presence of CKD or not. The majority of the patients had had T2DM for more than five years with at least two comorbidities, and they were mostly overweight or obese. Almost half of the patients (with or without CKD) had not achieved the LDL target (<2.6 mmol/L). More than half of the patients had uncontrolled blood pressure and glycaemic control, especially those with T2DM with CKD. Insulin was initiated mainly due to poor glycaemic control despite optimally tolerated OGLDs.

Simple logistic regression analysis revealed that CKD among T2DM patients was significantly associated with longer duration of diabetes, higher BMI in kg/m², poor blood pressure and glycaemic control, the grades of retinopathy, and treatment received, as shown in Table II. Multiple logistic regression analysis (Table II) showed that only blood pressure, HbA1c and grade of retinopathy were significantly associated with CKD among these T2DM patients. Respectively, T2DM patients with poor blood pressure control (≥130/80 for CKD patients or ≥140/80 for non-CKD patients) were 2.634 (95% CI=1.482, 4.684) times at higher odds (at risk) with the *p*-value of 0.001, while those with poor glycaemic control (HbA1c ≥7%) were 4.178 (95% CI=2.363, 7.387) times at higher odds of having CKD compared to those with good blood pressure or glycaemic control. Those with mild Nonproliferative Diabetic Retinopathy (NPDR), moderate NPDR, and those with unknown status of retinopathy were 7.472 (95% CI=3.817, 14.627), 13.594 (95% CI=3.609, 51.206), and 4.787 (95% CI=2.239, 10.235) at higher odds of having CKD compared to those with no retinopathy.

DISCUSSION

Most patients in this study were Malay and females, which is similar to another study.[12] Such an ethnic distribution may be attributable to the population of the Kuantan area, which is predominantly Malay (78.5%). A similar distribution was observed in the latest Malaysia National Diabetes Registry 2020, which the highest prevalence of T2DM was recorded in the population of this age group.[3] Centres for Disease Control and Prevention (CDC) has highlighted CKD is common in diabetes mellitus(DM) patients, with approximately one in three adults with DM having CKD. CKD prevalence in DM varies widely between countries ranging from 27.1% in Shanghai, China, to 83.6% in Tanzania.[4] In this study, the prevalence of CKD among T2DM patients attending primary health

Table I: Socio-demographic and clinical profile among Type 2 diabetic patients in Kuantan.

Characteristics	Overall (n=304)	Chronic Kidney Disease (CKD)	
		Yes (n=168) (55.3%)	No (n=136) (44.7%)
	Freq.[a] (%)	Freq.[a] (%)	Freq.[a] (%)
Age (years):	59.1 (8.89)[b]	59.4 (9.05)[b]	58.7 (8.70)[b]
< 60	170 (55.9)	88 (52.4)	82 (60.3)
> 60	134 (44.1)	80 (47.6)	54 (39.7)
Gender:			
Male	129 (42.4)	73 (43.5)	56 (41.2)
Female	175 (57.6)	95 (56.5)	80 (58.8)
Race:			
Malay	210 (69.1)	121 (72.0)	89 (65.4)
Chinese	67 (22.0)	31 (18.5)	36 (26.5)
Indian	27 (8.9)	16 (9.5)	11 (8.1)
Duration of diabetes (years):			
< 5	53 (17.4)	21 (12.5)	32 (23.5)
5 - 10	134 (44.1)	77 (45.8)	57 (41.9)
> 10	117 (38.5)	70 (41.7)	47 (34.6)
Smoking status:			
No	227 (74.7)	121 (72.0)	106 (77.9)
Yes	77 (25.3)	47 (28.0)	30 (22.1)
Comorbidities:			
Nil	2 (0.7)	1 (0.6)	1 (0.7)
1	27 (8.9)	15 (8.9)	12 (8.8)
2	140 (46.1)	68 (40.5)	72 (52.9)
> 3	135 (44.4)	84 (50.0)	51 (37.5)
Body Mass Index (kg/m²):	28.9 (5.77)[b]	29.7 (6.01)[b]	27.8 (5.30)[b]
< 18.5 (underweight)	4 (1.3)	1 (0.6)	3 (2.2)
18.5 - 24.9 (normal)	69 (22.7)	34 (20.2)	35 (25.7)
25.0 - 29.9 (overweight)	115 (37.8)	63 (37.5)	52 (38.2)
> 30 (obese)	116 (38.2)	70 (41.7)	46 (33.8)
Blood pressure (mmHg):			
Good control[c]	151 (49.7)	64 (38.1)	87 (64.0)
Poor control[d]	153 (50.3)	104 (61.9)	49 (36.0)
HbA1c (%):	7.35 (2.7)*	8.40 (3.3)*	6.55 (1.5)*
Good control (< 7)	138 (45.4)	47 (28.0)	91 (66.9)
Poor control (> 7)	166 (54.6)	121 (72.0)	45 (33.1)
LDL[e] (mmol/L):	2.7 (0.98)[b]	2.8 (1.05)[b]	2.7 (0.88)[b]
< 1.8	37 (12.2)	19 (11.3)	18 (13.2)
1.8 - 2.6	127 (41.8)	71 (42.3)	56 (41.2)
> 2.6	140 (46.1)	78 (46.4)	62 (45.6)
Grades of retinopathy:			
No retinopathy	126 (41.4)	33 (19.6)	93 (68.4)
Mild NPDR[f]	93 (30.6)	72 (42.9)	21 (15.4)
Moderate NPDR[f]	26 (8.6)	23 (13.7)	3 (2.2)
PDR[g] / ADED[h]	5 (1.6)	3 (1.8)	2 (1.5)
Unknown	54 (17.8)	37 (22.0)	17 (12.5)
Diabetic treatment:			
OGLDs[i] only	173 (56.9)	77 (45.8)	96 (70.6)
Insulin only	12 (3.9)	12 (7.2)	0 (0.0)
Insulin + OGLDs[i]	119 (39.1)	79 (47.0)	40 (29.4)
Indication of insulin initiation:			
Advanced diabetic complications	3 (1.0)	3 (1.8)	0 (0.0)
Symptomatic hyperglycaemia regardless of HbA1c	1 (0.3)	1 (0.6)	0 (0.0)
HbA1c > 10% or FBS[j] > 13 mmol/L on diagnosis	15 (4.9)	13 (7.7)	2 (1.5)
Poor glycaemic control despite optimal OGLDs[i]	114 (37.5)	74 (44.0)	40 (29.4)
Not on insulin	173 (56.9)	77 (45.8)	94 (70.6)

[a]frequency
[b]Mean (standard deviation)
[c]<130/80 for CKD, <140/80 for non-CKD
[d]≥130/80 for CKD, ≥140/80 for non-CKD
[e]low-density lipoprotein cholesterol
[f]Non-Proliferative Diabetic Retinopathy
[g]Proliferative Diabetic Retinopathy
[h]Advanced Diabetic Eye Disease
[i]oral glucose-lowering drugs
[j]fasting blood sugar
*Median (interquartile range) #with 2 missing values

Table II: Factors associated with chronic kidney disease among Type 2 diabetic patients in Kuantan using Simple Logistic Regression for univariate analysis and Multiple Logistic Regression for multivariable analysis (n=304).

Characteristics	Univariate analysis		Multivariable analysis[a]	
	Odds ratio (OR) (95% CI[b])	p-value	Adjusted OR (95% CI[a])	p-value
Age (years):				
< 60	Reference	-	-	-
> 60	1.380 (0.873, 2.182)	0.168	-	-
Gender:				
Male	Reference	-	-	-
Female	0.911 (0.576, 1.440)	0.690	-	-
Race:				
Malay	Reference	-	-	-
Chinese	0.633 (0.364, 1.101)	0.105	-	-
Indian	1.070 (0.474, 2.417)	0.871	-	-
Duration of diabetes (years):				
< 5	Reference	-	-	-
5 - 10	2.058 (1.076, 3.936)	0.029	-	-
> 10	2.270 (1.169, 4.404)	0.015	-	-
Smoking status:				
No	Reference	-	-	-
Yes	1.372 (0.810, 2.325)	0.239	-	-
Body Mass Index (kg/m²):			-	
< 18.4 (underweight)	Reference	-	-	-
18.5 - 24.9 (normal)	2.914 (0.289, 29.414)	0.365	-	-
25.0 - 29.9 (overweight)	3.635 (0.367, 35.991)	0.270	-	-
> 30 (obese)	4.565 (0.461, 45.241)	0.194	-	-
Blood pressure (mmHg):				
Controlled[c]	Reference	-	Reference	
Uncontrolled[d]	2.885 (1.806, 4.609)	<0.001	2.634 (1.482, 4.684)	0.001
HbA1c (%):			-	-
Good control	Reference	-	Reference	
Poor control	5.206 (3.186, 8.506)	<0.001	4.178 (2.363, 7.387)	<0.001
Comorbidities:				
Nil	Reference	-	-	-
1	1.250 (0.071, 22.132)	0.879	-	-
2	0.944 (0.058, 15.400)	0.968	-	-
> 3	1.647 (0.101, 26.911)	0.726	-	-
Grades of retinopathy:				
No retinopathy	Reference	-	Reference	
Mild NPDR	9.662 (5.158, 18.100)	<0.001	7.472 (3.817, 14.627)	<0.001
Moderate NPDR	21.606 (6.086, 76.703)	<0.001	13.594 (3.609, 51.206)	<0.001
PDR / ADED	4.227 (0.676, 26.425)	0.123	2.793 (0.376, 20.753)	0.316
Unknown	6.134 (3.051, 12.330)	<0.001	4.787 (2.239, 10.235)	<0.001
LDL[e] (mmol/L):			-	-
< 1.8	Reference	-	-	-
1.8 - 2.6	1.201 (0.577, 2.502)	0.624	-	-
> 2.6	1.192 (0.577, 2.463)	0.636	-	-
*Diabetic treatment:				
OGLDs[f] only	Reference	-	-	-
Insulin (with or without OGLDs[f])	2.836 (1.759, 4.573)	<0.001	-	-

[a]Included all the significant variables from simple logistic regression in the analysis but only the significant variables are reported
[b]confidence interval
[c]<130/80 for CKD, <140/80 for non-CKD
[d]≥130/80 for CKD, ≥140/80 for non-CKD
[e]low-density lipoprotein cholesterol
[f]oral glucose lowering drugs
Significant at α=0.05

clinics in Kuantan was 55.3% (95% CI=54.8-55.9%). This finding was a bit higher than most similar studies conducted in other nations, where the percentage of CKD was reported to be around 30% to 40%. Nevertheless, a study conducted in a primary care polyclinic in the northern region of Singapore found that 53% of T2DM patients had CKD, similar to this study.[13] Additionally, CKD was found to affect about 50% of patients with T2DM globally.[14] CKD was more common in certain patient populations, including the elderly, those with youth -onset DM, obese, and specific ethnic groups.[15] This study was done in a suburban region, with a multi-ethnicity population which may contribute to the higher range of CKD prevalence, due to the clinical, metabolic, socioeconomic, and behavioural factors.[16,17] It is also expected that the prevalence might be lower compared to a tertiary setting.[18]

Among T2DM patients with CKD, 87.5% had diabetes for five years or more, 90.5% had at least two comorbidities, including hypertension or dyslipidaemia, which reflects a high prevalence of multimorbidity, defined as the co-occurrence of at least two chronic noncommunicable diseases in the same individual. The prevalence of overweight and obesity in T2DM with CKD was 37.5% and 41.7%, respectively. The mean body mass index was 29.7 kg/m^2. The prevalence of overweight and obesity was higher compared to the national prevalence which was 30.4% and 19.7%, respectively.[2] The metabolic effect of T2DM may have contributed to the greater prevalence of obesity and overweight in this study, which shows that obesity has a recognized association with T2DM with or without CKD. In fact, Malaysia has the highest prevalence of adult obesity in Southeast Asia, which is a risk factor for a number of non-communicable diseases.[19]

In this study, slightly more than half of the patients failed to achieve the targeted blood pressure control as outlined by the Malaysian Clinical Practise Guideline (CPG) for the Management of DM.[11] Most of the patients with uncontrolled blood pressure were among those with CKD, with similar findings for glycaemic control. The measurement of HbA1c serves as the indicator for assessing diabetes management. In Malaysia, the National Diabetes Registries (NDR) has implemented an annually audited programme, which aims to achieve a target of over 30% of randomly selected patients with an HbA1c level below 6.5% for all T2DM patients.[3] In this study, good glycaemic control of T2DM with CKD was taken as less than 7% as recommended by the CPG[11]. 28% of the T2DM patients with CKD in this study achieved good glycaemic control, almost achieving the NDR target. The majority of T2DM patients with CKD (88.7%) have LDL levels greater than 1.8 mmol/L, which is considered an unmet goal for high-risk individuals.[11] The high prevalence of CKD among T2DM patients in this study could be attributed to high blood pressure and poor glycaemic control. It was proven that hypertension and poor glycaemic control, as well as dyslipidaemia, are associated with the occurrence and progression of CKD.[20]

Pharmacological treatment analysis showed that 54.2% of T2DM with CKD were on insulin. Biguanides and sulphonylureas were the two groups of OGLDs most commonly used due to their availability in primary care, cost-effectiveness, good reputation, and acceptance.[21] For many years, CPG has consistently advocated the utilisation of angiotensin-converting enzyme inhibitors (ACEis) or angiotensin receptor blockers (ARBs) in the management of CKD in T2DM patients.[11] In addition, sodium-glucose cotransporter 2 inhibitor (SGLT2i) medications are highly recommended for patients with T2DM and CKD.[10] In the foreseeable future, it is anticipated that a variety of potentially efficacious and recommended treatments for CKD may become readily accessible within primary care settings, such as glucagon-like peptide-1 receptor agonists (GLP-1RAs) and the nonsteroidal mineralocorticoid receptor antagonist (MRA) known as finerenone.

Multivariable analysis showed that poor glycaemic control, uncontrolled blood pressure, mild NPDR and moderate NPDR were significantly associated with T2DM with CKD. Hyperglycemia triggers a series of pathological processes, resulting in a progressive decline in the glomerular filtration rate. T2DM with poor glycaemic control had a four times higher risk of developing CKD compared to those with good glycaemic control. This finding corroborates the reports in other studies whereby an increased risk of developing CKD was observed among patients with poor glycaemic control.[22] The beneficial

effect of early intensive glycaemic control in reducing the risk of CKD was conclusively demonstrated in landmark trials, the Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS).[23] Additionally, this study identified uncontrolled blood pressure as one independent risk factor for CKD. Another study has also highlighted a similar result of a strong association between uncontrolled blood pressure and CKD in T2DM patients.[24] In general population, hypertension is a significant risk factor for CKD, and equally, CKD is the most prevalent cause of secondary hypertension. A local study among hypertensive population revealed that T2DM increased the risk of developing CKD by 2.621% compared to non-diabetic individuals.[25]

Diabetic retinopathy and diabetic-related CKD are both caused by microvascular damage in these organs. The eye and the kidney have significant similarities in their developmental, anatomical, and pathological pathways. Thus, CKD frequently correlates with the presence of diabetic retinopathy. A multivariable analysis revealed that both mild NPDR and moderate NPDR were identified as risk factors for CKD in T2DM patients. This finding was supported by several studies which demonstrated similar findings and a significant association between diabetic retinopathy and CKD progression.[26,27] In Malaysia, a consistent pattern of retinopathy and CKD prevalence among T2DM patients was observed in each annual report, suggesting a strong correlation between these two conditions.[3] Consequently, retinal vascular assessments, such as office fundoscopy or camera fundoscopy, which are readily accessible in primary care clinics, may have the potential to aid in the prediction of CKD outcomes among T2DM with retinopathy. PDR is a highly specific indicator for the diagnosis of diabetic-related CKD.[28] Although Proliferative Diabetic Retinopathy (PDR) or Advanced Diabetic Eye Disease (ADED) was found to have higher odds of having CKD than those with no retinopathy, it was not significant statistically, which could be due to the small number of T2DM patients with PDR or ADED in this study.

Given the high cost of care in managing CKD complications, preventive strategies are shifting towards primary prevention. Early screening for T2DM in the population is crucial for early diagnosis and treatment to detect asymptomatic T2DM, whereby early interventions have the potential to yield positive outcomes and prevent the progression of diabetic complications, including CKD. Identifying evidence of kidney injury using UACR or eGFR is secondary prevention, which is widely available in primary care clinics.[29,30] Early diagnosis of CKD in T2DM may prevent progression to ESKD, lower the risk of cardiorenal metabolic complications and death, improve quality of life and reduce healthcare costs.

There are several strengths of this study. Despite the high prevalence of T2DM and CKD, very little is known about CKD among T2DM and its associated risk factors in Malaysia, particularly in Pahang. Significant factors associated with CKD in T2DM patients were identified in this study, including poorly controlled glycaemic, uncontrolled blood pressure, and retinopathy status. Additionally, this study unveiled the socio-demographic and clinical profile among T2DM patients at primary health clinics with and without CKD. It could serve as a guide for the implementation of more effective surveillance for T2DM patients and aggressive intervention can be steered to curb the disease complications.

Despite these strengths, the cross-sectional design of this study comes with its limitations. Using the secondary data, this study was able to identify the factors associated with CKD but could not confirm the cause-and-effect relationship between the variables. Moreover, this study was only able to report the prevalence of CKD among T2DM patients, which might also be comprised of CKD with hypertension or other renal diseases due to the difficulties in confirming the presence of diabetic kidney disease per se from the clinical records. For adults, the WHO definition of overweight and obesity was used for the analysis, which might result in a slight discrepancy in the BMI descriptive analysis. Purposive sampling was used to select the largest primary health clinics in Kuantan, which is a limitation as the data might not represent the entire Malaysian T2DM population. Thus, the generalizability of this study's findings to other T2DM populations in Malaysia might warrant further study.

CONCLUSION

Around half of T2DM patients in this study had evidence of CKD. Those with poor glycaemic control and high blood pressure had a higher risk of having CKD compared to the groups with good control. Hence, aggressive intervention should be well-thought-out for all primary care T2DM patients to achieve good glycaemic and blood pressure control to curb the progression of CKD. It is imperative to do a timely retinal examination for early identification of retinopathy status as it is associated with CKD progression. The challenge is to develop the most effective approach to perpetually improve diabetes management, and effectively prevent CKD progression at the primary care.

AUTHOR CONTRIBUTION

Fa'iza Abdullah was involved in the conceptualisation of the study, data collection and reviewing as well as editing the writing of the paper. Qamarul Azwan and Muhammad Arif Mustaqim were involved in the data collection, initial data analysis and drafting of the manuscript. Nor Azlina was responsible for checking and finalising the data analysis and editing of the paper, while Mohd Aznan was involved in the manuscript revision for important intellectual content. All authors have agreed and are accountable for the final manuscript.

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CONFLICT OF INTEREST

All authors have no conflicts of interest to declare.

INSTITUTIONAL REVIEW (ETHIC COMMITTEE)

Ethical approval for this research was obtained from IIUM Kulliyyah Research Committee (IIUM/305/20/4/1/7) (Research ID: 693) and The Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH) (NMRR-21-1834-60299).

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per guidelines)

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